CHAPTER 2

The Environmental Protection Indicators for California (EPIC) Process

Scope of the EPIC Project

The EPIC Project develops and maintains an environmental indicator system that:

- Reflects an issue that affects California, or a global or transboundary issue of interest to California.
- Relates to the missions of Cal/EPA and its boards, departments and offices. To the extent that these missions overlap with those of the Resources Agency, the Department of Health Services and other state agencies, those areas are addressed by the project. (Indicators that address areas that are primarily the responsibility of the Resources Agency will be developed and implemented under that agency's strategic planning functions.)
- Measures pressures exerted on the environment by human activities, ambient environmental conditions, or effects on human or ecological health. Measures of program performance, activity, efficiency or outputs are not within the scope of the project*.

These qualifying considerations guide the determination of important environmental issues and sub-issues from which indicators are developed.

The Indicator Identification and Selection Process

The process of identifying and selecting indicators under the EPIC Project is illustrated in the flowchart in Figure 3.

Identification of environmental issues.

The identification of significant environmental ***issues*** for California provides a focus for indicator development. Whenever possible, components of the issues, or sub-issues, are identified. Related issues and sub-issues are organized into an ***issue structure***. The issue structure provides a starting point for the identification of possible environmental indicators. The issue structure is intended to be flexible to allow the addition, removal or modification of issues and sub-issues in the future.

During the first year of the EPIC Project, issues were identified based on input from internal staff, as well as from participants at a two-day conference (*Environmental Protection Indicators for California: Building an Environmental Indicator System for Cal/EPA*, held January 18 and 19, 2001, in Sacramento), and the Interagency and External Advisory Groups. Similar issues were grouped into issue categories (air quality, water, land/waste/materials management, pesticides, human health, ecosystem health, and transboundary issues). Although various ways of organizing issues were explored, the issue categories chosen paralleled areas of authority within Cal/EPA. This facilitated the identification of possible indicators and data sources.

*Appendix B provides information on the range of indicators that can be used to assess an organization's performance.

Definition of Terms Used in EPIC

Parameter: A property (e.g., pollutant concentration, pollutant discharge quantity, chemical body burden) that is measured or observed.

Measure: indicator: Raw or analyzed data obtained from monitoring, surveys and other valid data collection methods. Measures form the basis for environmental indicators.

Environmental indicator: A value that presents scientifically based information on the status of, and trends in, environmentally-related parameters. An indicator conveys complex information in a concise, easily understood format, and has a significance extending beyond that directly associated with the measure(s) from which it is derived.

Integrative An indicator that captures multiple aspects of a given issue or system such that its significance extends beyond the measure(s) from which it is derived to a greater degree than other available indicators.

Index: A type of environmental indicator derived from a set of aggregated or weighted indicators or measures.

Indicator suite: A group of indicators that collectively presents information on major environmental issues, such as climate change, toxic contamination, biological diversity, hazardous waste, pesticides, ecosystem health, or use of natural resources (energy, fisheries, forests, public lands, soil and water).

Issue: A topic of environmental concern to California, including its components or dimensions, or sub-issues. Environmental issues can exist on a local to statewide scale, and provide the foundation for identifying environmental indicators.

Issue structure: The organization of issues and sub-issues that guide the development of environmental indicators.

Identification of relevant parameters.
Each issue is examined to determine whether relevant properties or ***parameters*** can be identified, which can then be used to derive candidate indicators. When an issue is not well understood, the appropriate parameters cannot be identified, indicating a need for further investigation.

Identification of candidate indicators.
Where one or more parameters can be identified for an issue, various ways of presenting these parameters, individually or in combination with other parameters, are identified.

Example of parameters and associated candidate indicators:
For ozone as a criteria air pollutant, parameters can include:

- emissions of ozone precursors (i.e., nitrogen oxides and volatile organic compounds);
- ambient ozone concentrations;
- number of exceedances of certain regulatory standards; and,
- vehicle-miles traveled.

Candidate indicators can include:

- total statewide ozone precursor emissions per year;
- statewide ozone precursor emissions per year per vehicle-mile traveled;
- maximum statewide ozone concentration per year; and,
- total number of days of exceedances of California standard.

Evaluation of candidate indicators based on primary criteria.
To ensure that EPIC indicators are of consistently high quality, candidate indicators are evaluated to verify that they meet all primary criteria. Data for each candidate indicator are assessed to ensure that they are collected using methods that are scientifically acceptable, and that they support sound conclusions about the state of the system or issue being studied. In addition, the indicator must closely represent the issue, be sensitive to changes in the issue being measured, and provide a meaningful basis for decision-making.

Ideally, an indicator should, at a minimum, meet all these criteria. However, there are special circumstances when the only available data set does not meet all primary criteria, but could nevertheless be used to develop a reasonably valid indicator. These guidelines allow for the selection of such indicators with the expectation that better quality data will be generated in the future. In these cases, the limitations of the data set(s) used for indicator development should be clearly documented in the narrative for the indicator.

When a candidate indicator does not meet the primary criteria and there is no prospect for the development of new data sets that would meet the criteria, the indicator is dropped from further consideration.

Guidelines for Indicator Selection: Primary Criteria

The indicator should meet all of the following criteria:

Data quality: Data are/will be collected to yield measures that are scientifically acceptable and support sound conclusions about the state of the system being studied.

Representativeness: The indicator is designed to reflect the environmental issue it is selected to characterize.

Sensitivity: The indicator should be able to distinguish meaningful differences in environmental conditions with an acceptable degree of resolution.

Decision support: The indicator should provide information appropriate for making policy decisions.

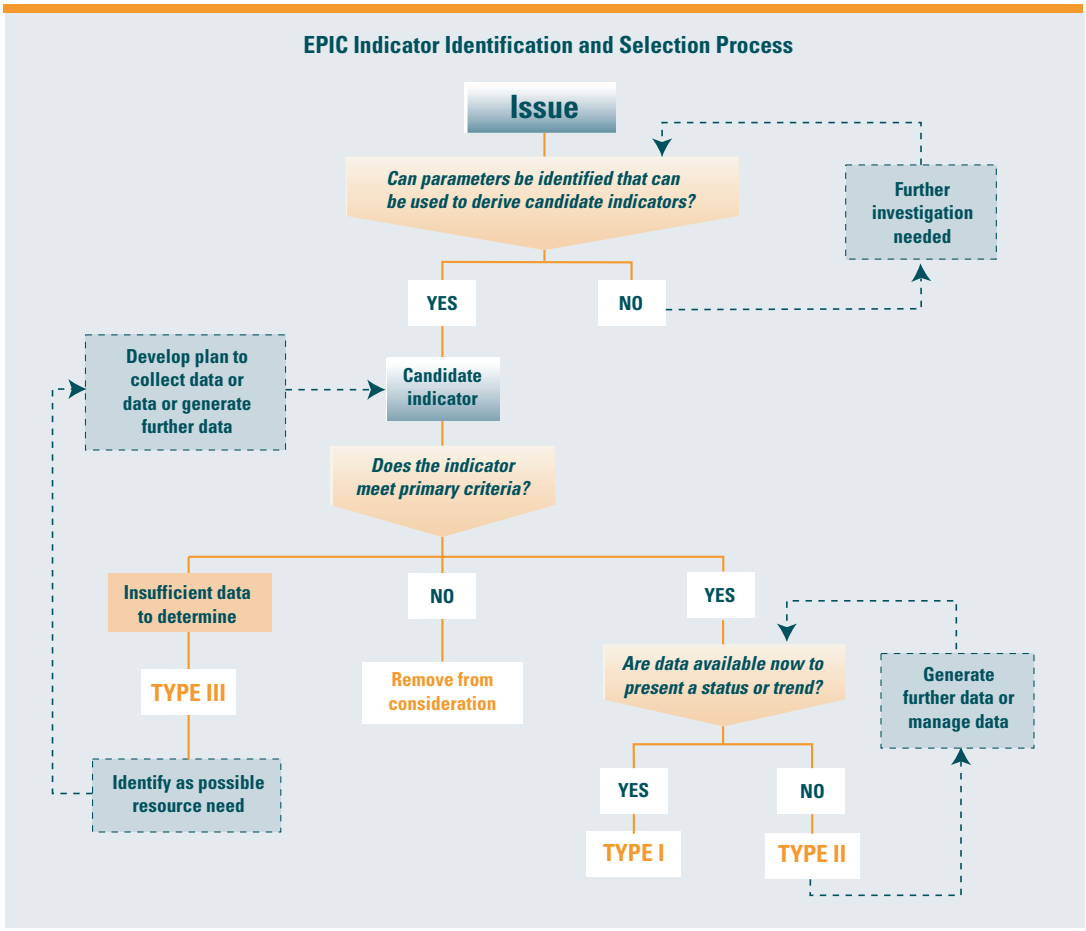

Figure 3

Characterization of data availability.
Candidate indicators meeting primary criteria are further evaluated as to whether data are available to present a status or trend for the issue in question. Where the data are available and are supported by ongoing, systematic monitoring and data collection efforts, the indicator is designated as a ***Type I indicator***.

When the data do not show a status or trend, either because a full cycle of data has not yet been collected, or the data require further analysis or management, the indicator is classified as a ***Type II indicator***.

There are instances when it cannot be determined whether a candidate indicator meets primary criteria because of insufficient data or because the data are from a one-time study. These indicators are classified as ***Type III indicators***. Type III indicators reveal a need for resources to develop a plan and/or implement a program for data collection.

Evaluation of Type I indicators based on secondary criteria.
Secondary criteria reflect other desirable, but nonessential, attributes of an environmental indicator. These criteria address whether an indicator can be used to anticipate changes, can be compared to indicators in other programs or systems, is cost-effective, and is based on, or can be compared to, a benchmark value. These characteristics are noted in the indicator sheets whenever appropriate.

Understandability is an essential characteristic of an environmental indicator. It is not a fixed attribute of an indicator, but rather a function of how the data for an indicator are presented. Where there can be several ways of presenting an environmental indicator, every effort is made to select the presentation that can be most easily understood by the broadest audience.

Classification of indicators based on data availability

Type I indicators: Adequate data are available and can be used to support the development of the indicator. These data are generated by ongoing, systematic monitoring or data collection efforts.

Type II indicators: Full or partial data generated by ongoing, systematic monitoring and/or collection are available, but either a complete cycle of data has not been collected, or further data analysis or management is needed in order to present a status or trend.

Type III indicators: No ongoing monitoring or data collection is in place to provide data for these indicators. At the present time, these indicators are conceptual or have not been developed beyond one-time studies that provide only a snapshot in time. Type III indicators are useful in revealing data gaps that may need to be filled in order to provide quantitative information on certain significant environmental issues.

Guidelines for Indicator Selection: Secondary Criteria

It is desirable, but not essential, that Type I indicators meet the following criteria:

Anticipatory: The indicator can provide an early warning of environmental change.

Data comparability: The indicator can be compared to indicators in other state, regional, national or international systems.

Cost-effective: Data collection efforts generate the type and amount of information needed to support the indicator, and can be carried out at a reasonable cost.

Benchmark value: The indicator is based on, or can be compared to, a benchmark value or point of reference, so that users can assess its significance.

Indicators integrate multiple aspects of a given issue or a system. Certain indicators can synthesize a considerable degree of information. These are termed ***integrative indicators***. The level of dissolved oxygen in a river or stream is an example of an integrative indicator. Oxygen is produced by plants and used by bacteria, invertebrates, and vertebrates. Its concentration in water reflects many interrelated processes within an aquatic ecosystem.

In certain cases, indicators can be combined, in a weighted or non-weighted fashion, into a single ***index*** to integrate a greater degree of information than the individual indicators.

Collectively, all the indicators that present information on an environmental issue comprise an ***indicator suite.***